

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : H04B 1/38, H04Q 7/32, H04M 1/72	A1	(11) International Publication Number: WO 95/02927 (43) International Publication Date: 26 January 1995 (26.01.95)
--	----	---

(21) International Application Number: PCT/US94/07617

(22) International Filing Date: 8 July 1994 (08.07.94)

(30) Priority Data:
093,076 16 July 1993 (16.07.93) US

(71) Applicant: ERICSSON GE MOBILE COMMUNICATIONS, INC. [US/US]; 1 Triangle Drive, P.O. Box 13969, Research Triangle Park, NC 27709 (US).

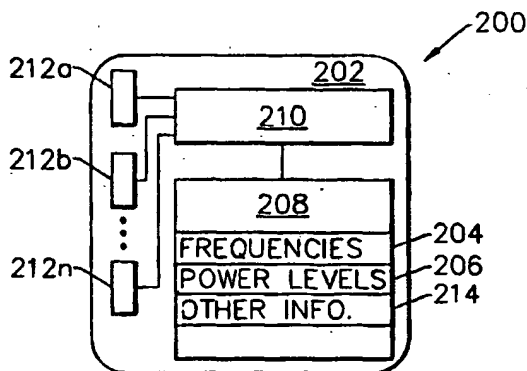
(72) Inventor: Rydbeck, Nils, Rutgers, 207 Queensferry Road, Cary, NC 27511 (US).

(74) Agents: BIGEL, Mitchell, S. et al.; Bell, Seltzer, Park & Gibson, P.O. Drawer 34009, Charlotte, NC 28234 (US).

(81) Designated States: FI, JP, KR, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published*With international search report.**Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.*

(54) Title: METHOD AND APPARATUS FOR CONTROLLING TRANSCEIVER OPERATIONS IN A RADIO COMMUNICATIONS SYSTEM



(57) Abstract

Transceiver frequency and power level are allocated in a radio communications system which includes a base station, a radio personal communications terminal, and a radio personal communications network, by using a smart card to store frequency and power level indicators. The stored indicators are used to set personal communications terminal-to-base station communications. The smart card may be removably coupled to the base station or the personal communications terminal. Since the smart cards are issued by the radio personal communications system carrier, appropriate frequencies and power levels can be assigned for base stations, to minimize same channel interference with the radio personal communications network.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	GB	United Kingdom	MR	Mauritania
AU	Australia	GE	Georgia	MW	Malawi
BB	Barbados	GN	Guinea	NE	Niger
BE	Belgium	GR	Greece/	NL	Netherlands
BF	Burkina Faso	HU	Hungary	NO	Norway
BG	Bulgaria	IE	Ireland	NZ	New Zealand
BJ	Benin	IT	Italy	PL	Poland
BR	Brazil	JP	Japan	PT	Portugal
BY	Belarus	KE	Kenya	RO	Romania
CA	Canada	KG	Kyrgyzstan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo	KR	Republic of Korea	SE	Sweden
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LI	Liechtenstein	SK	Slovakia
CM	Cameroon	LK	Sri Lanka	SN	Senegal
CN	China	LU	Luxembourg	TD	Chad
CS	Czechoslovakia	LV	Latvia	TG	Togo
CZ	Czech Republic	MC	Monaco	TJ	Tajikistan
DE	Germany	MD	Republic of Moldova	TT	Trinidad and Tobago
DK	Denmark	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	US	United States of America
FI	Finland	MN	Mongolia	UZ	Uzbekistan
FR	France			VN	Viet Nam
GA	Gabon				

METHOD AND APPARATUS FOR CONTROLLING TRANSCEIVER OPERATIONS IN A RADIO COMMUNICATIONS SYSTEM

Field of the Invention

This invention relates to communications systems and more particularly to radio communications systems.

5

Background of the Invention

Radio communication systems are increasingly being used for wireless mobile communications. An example of a radio communication system is a cellular
10 phone system. The design and operation of an analog cellular phone system is described in an article entitled *Advanced Mobile Phone Service* by Blecher, IEEE Transactions on Vehicular Technology, Vol. VT29, No. 2, May, 1980, pp. 238-244. The analog mobile cellular
15 system is also referred to as the "AMPS" system.

Recently, digital cellular phone systems have also been proposed and implemented using a Time-Division Multiple Access (TDMA) architecture. Standards have also been set by the Electronics
20 Industries Association (EIA) and the Telecommunications Industries Association (TIA) for an American Digital Cellular (ADC) architecture which is a dual mode analog and digital system following EIA/TIA document IS-54B. Telephones which implement the IS-54B dual mode

-2-

architecture are presently being marketed by the assignee of the present invention.

Different standards have been promulgated for digital cellular phone systems in Europe. The European digital cellular system, also referred to as GSM, also uses a TDMA architecture. The GSM also uses a Subscriber Identification Module (SIM) which is removably coupled to a cellular phone in order to provide subscriber identification. The SIM is implemented using a "smart card", also referred to as a "chip card", which contains information such as a subscription number, telephone number and authentication codes in an embedded chip. The SIM can be exchanged between telephone units so that the user can insert the SIM into any compatible telephone. Cellular telephones using smart cards are also described in U.S. Patents 5,091,942 to Dent; 5,134,717 to Soggard Rasumussen; and 5,153,919 to Reeds, III et al. Citizens band (CB) radios are also known, which use removable crystals to set oscillator frequency.

Proposals have recently been made to expand the cellular phone system into a radio personal communications system. The radio personal communications system provides mobile radio voice, digital, video and/or multimedia communications using radio personal communications terminals. Thus, any form of information may be sent and received. Radio personal communications terminals include a radio telephone, such as a cellular telephone, and may include other components for voice, digital, video and/or multimedia communications.

A radio personal communication system includes at least one base station. A base station is a low power transceiver which communicates with a radio personal communications terminal such as a cellular telephone over a limited distance, such as tens of meters, and is also electrically connected to the

-3-

conventional wire network. The base station allows the owner of a radio personal communications terminal to directly access the wire network without passing through the radio personal communications network, such as the cellular phone network, whose access rates are typically more costly. When located outside the range of the base station, the personal communications terminal automatically communicates with the radio personal communications network at the prevailing access rates.

A major problem in implementing a radio personal communication system is the frequency overlap between the radio personal communications network (e.g., cellular phone network) and the base station. As understood by those having skill in the art, only a limited number of frequencies are available for radio communications. In the United States, cellular telephones have been allocated 832 30kHz wide channels. Within this spectrum, each regional provider can substantially allocate and use these frequencies as it sees fit.

In a radio personal communications system, it is assumed that base station transmission will be in the same frequency spectrum as the radio personal communications network. Accordingly, the possibility of same channel interference arises when a base station is operating at the same channel as the network covering the same area.

Frequency overlap between the network and the base stations can be prevented if the network and base stations are allocated different bands of frequencies. However, such a hybrid system is not an efficient allocation of the frequency spectrum. Moreover, a hybrid personal communications terminal may be more expensive and complicated because additional circuitry may be required. Accordingly, in order to efficiently provide a radio personal communications system, it is

-4-

desirable to provide base stations which operate in the same frequency bands as the radio personal communications networks, while avoiding same channel interference.

5

Summary of the Invention

It is therefore an object of the present invention to provide an improved radio personal communications system and method.

10 It is another object of the present invention to provide a radio personal communications system and method wherein same channel interference between the radio personal communications network, such as the cellular telephone network, and the base stations, are reduced.

15

These and other objects are obtained, according to the present invention, by providing frequency indicating means, preferably a smart card, for storing therein an indicator of at least one radio transmission frequency. The radio personal communications terminal and/or base station is adapted for removably coupling the frequency indicating means thereto and for controlling the radio personal communications terminal and/or base station to operate at a frequency corresponding to a frequency which is stored in the smart card. Since the smart cards are issued by the radio personal communications system carriers, appropriate frequencies can be assigned for the base stations, to minimize same channel interference with the radio personal communications network. Moreover, by allowing radio personal communications system carriers to lease unused frequencies via smart cards, additional revenue may be generated from these frequencies.

20
25
30
35

Preferably, according to the invention, the frequency indicating means (smart card) also stores therein a second indicator of at least one power level,

-5-

and the radio personal communications terminal and/or base station operates at a frequency and power level corresponding to that which is stored in the smart card. The base station is preferably adapted for
5 removably receiving the frequency and power level indicating means (smart card) and for controlling the transmission frequency and power of the base station to correspond to the stored frequency and power level. A
10 stored frequency and power level are also preferably provided to the personal communications terminal which communicates with the base station, so that the terminal also transmits at a frequency and power level which is compatible with that of the base station.

Alternatively, the frequency and power level
15 indicating means (smart card) may be contained within the radio personal communications terminal. Then, when establishing contact with the base station, the terminal can set the frequency and power level of the base station and of the terminal based on a power level
20 and frequency stored in the smart card.

In a method according to the present invention, a base station for a radio telephone network is operated to reduce same channel interference with the radio telephone network by electrically connecting
25 the base station to a wire telephone network and by receiving a frequency indicating signal, and also preferably a power level indicating signal, from a source external to the base station. The base station transceiver is then operated at a frequency, and
30 preferably at a power level, corresponding to the received frequency and power level indicating signals. Preferably, the frequency and power level indicating signals are received by removably coupling a smart card, including a stored indication of at least one
35 radio transmission frequency and power level, to the base station, and obtaining from the coupled smart card, signals representing the at least one radio

-6-

transmission frequency and power level. The base station also preferably transmits a frequency and power level signal, based upon the stored indicators to a radio telephone with which it communicates, so that the
5 radio telephone also can operate at a frequency and power level which is compatible with the base station.

In an alternate method, the radio telephone is adapted for removably coupling a smart card thereto, where the smart card includes at least one stored
10 indication of the radio transmission frequency and preferably a power level. The radio telephone transceiver is controlled to operate at a frequency and power level corresponding to the stored frequency and power level in the smart card. The radio telephone
15 also transmits signals representing a radio transmission frequency and preferably a power level, to the base station, so that the base station can operate at this power level.

The use of smart cards for storing frequency
20 and power level indications allows the network operator to assign frequencies for base stations which minimize same channel interference with the radio network. The system carrier also can obtain additional revenue from unused frequencies within a network cell by leasing
25 these frequencies for base station operation within the cell. An improved radio personal communications system and method is thereby provided.

Brief Description of the Drawings

Figures 1A and 1B schematically illustrate a
30 radio personal communication system including a base station and a radio personal communications terminal, with radio communications between the terminal and the base station, and radio communications between the terminal and a radio personal communications network,
35 respectively.

-7-

Figure 2 is a schematic block diagram of frequency and power level indicating means according to the present invention.

Figure 3 is a schematic block diagram of a
5 base station according to the present invention.

Figure 4 is a schematic block diagram of a base station radio frequency transceiver according to the present invention.

Figure 5 is a schematic block diagram of a
10 radio personal communications terminal according to the present invention.

Figure 6 is a flowchart illustrating operations of a radio personal communication system according to the present invention.

15 Description of Preferred Embodiments

The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may,
20 however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those
25 skilled in the art.

Referring now to Figures 1A and 1B, conceptual diagrams of a radio personal communications system are shown. As shown in Figure 1A, radio personal communications system 100 includes at least
30 one radio personal communications network 102, such as a cellular telephone cell, for transmitting and receiving messages in a network range indicated by 104, via cell antenna 106. Network 102 also interfaces with the wired network 108. It will be understood by those
35 having skill in the art that a radio personal communication system 100 typically includes many radio

-8-

personal communication networks, or cells, 102 to cover a large area.

Still referring to Figure 1A, system 100 also includes a base station 110. Base station 110 includes
5 a low power transceiver for transmitting and receiving via base station antenna 112, over a limited base station range 114, typically on the order of tens of meters. Thus, a base station may be used for transmission and receipt of radio personal
10 communications in a home or office. Base station 110 also is electrically connected to the wire network 108.

Still referring to Figure 1A, a radio personal communications terminal 120 is shown for radio communications with both base station 110 and network
15 102 via antenna 122. Radio personal communications terminal includes a radio telephone such as a cellular phone. Radio personal communications terminal 120 may also include, for example, a full computer keyboard and display, a scanner, and full graphics and multimedia
20 capabilities.

As illustrated in Figure 1A, when terminal 120 is in the range 114 of the base station 110, a radio link 124 therebetween is automatically established. As shown in Figure 1B, when the terminal
25 120 is outside the range 114 of the base station 110, but within the range 104 of the network 102, a new radio link 126 is automatically established with the network 102. Thus, when the user is relatively close to the base station 110 (i.e. within the home or
30 office), wireless communications take place with the base station so that the radio personal communications network 102, with its higher rate structure, is bypassed. When the user is relatively far from the base station 110, communications take place with the
35 network 102.

It will be understood by those having skill in the art that a complete radio personal

-9-

communications system 100 will typically include many base stations 110, terminals 120 and radio networks (cells) 102. It will also be understood by those having skill in the art that conventional communications and handoff protocols may be used with the present invention, and need not be described further herein. For purposes of this description, it will be assumed that the spectrum allocation is the IS-54B cellular phone spectrum allocation which is illustrated in Table 1 below.

TABLE 1

System	Bandwidth (MHz)	Number of Channels	Boundary Channel Number	Transmitter Center Frequency (MHz)	
				MOBILE	BASE
Not Used		1		(824.010)	(869.010)
A'	1	33	991 1023	824.040 825.000	869.040 870.000
A	10	333	1 333	825.030 834.990	870.030 879.990
B	10	333	334 666	835.020 844.980	880.020 889.980
A'	1.5	50	667 716	845.010 846.480	890.010 891.480
B'	1.5	83	717 799	846.510 848.970	891.510 893.970

Transmitter	Channel Number	Center Frequency (MHz)
MOBILE	$1 \leq N \leq 799$	$0.030 N + 825.000$
	$990 \leq N \leq 1023$	$0.030 (N-1023) + 825.000$
BASE	$1 \leq N \leq 799$	$0.030 N + 870.000$
	$990 \leq N \leq 1023$	$0.030 (N-1023) + 870.000$

In the radio personal communication system 100 described in Figures 1A and 1B, it is important to avoid same channel interference between base station 110 and network 102. According to the invention, the operator of network 102, which has been assigned the

-10-

use of the frequency spectrum in the region by a regulatory authority, is allowed to assign frequencies and preferably power levels, of base station 110. The network operator can assign frequencies and preferably power levels to base station 110 to minimize same channel interference and to maximize revenue from the assigned frequency spectrum. Frequency indicating means, in the form of a smart card, removable memory module or other token, is removably coupled to the base station 110 or personal communications terminal 120 to provide frequency information, and also preferably power level information, which governs terminal-to-base station communications.

Figure 2 illustrates a frequency and power level indicating means according to the invention. As shown, frequency and power level indicating means 200 is preferably a smart card 202, also referred to as a "chip card", or other token, which includes memory means 208 for storing therein indications of at least one radio transmission frequency 204 and at least one power level 206. Memory 208 is preferably an electrically erasable programmable read only memory (EEPROM), which operates under control of a controller 210. A plurality of smart card electrical contacts 212a-212n, only three of which are illustrated in Figure 2, allow communication of the frequency and power level indicators 204, 206 external to the smart card 202. It will be understood by those having skill in the art that memory 208 may also contain other information 214, for example identification information such as subscription number, telephone number and authentication codes, and/or other preprogrammed telephone numbers. A smart card is currently used in the European digital cellular system (GSM) for purposes of subscriber identification. The GSM smart card is referred to as a Subscriber Identification Module (SIM)

-11-

and is described in International Standards ISO 7816-1, -2, and -3.

Figure 3 illustrates a block diagram of a preferred embodiment of the present invention, in which
5 a base station 110 includes means for removably coupling the frequency and power level indicating means 200 thereto. Figure 3 illustrates a recess 302 for removably coupling the frequency and power level indicating means 200 to base station 110. However,
10 other removable coupling arrangements may be provided. Contacts 212a-212n electrically contact corresponding base station contacts 304a-304n for obtaining signals representing the frequency and power level indications 204, 206 from smart card 202. It will be understood
15 that electromagnetic, optical or other means may also be used to obtain the signals from the removably coupled smart card 202.

According to the invention, base station 110 uses the obtained frequency and power level 204, 206,
20 respectively, to govern operation of base station 110. Frequency and power level signals are also preferably used to control operation of the radio personal communications terminal 120 as will be described below. As will also be described below the terminal 120 may be
25 controlled to operate at the same frequency and power level as base station 110. Alternatively, a different frequency and power level may be provided. If a different frequency or power level is used, smart card 202 may store multiple frequencies 204 and power levels
30 206. Alternatively, the base station 110 or terminal 120 may determine the second frequency and power level from a single stored indication in smart card 202. The base station 110 is preferably configured so that it will not operate without a frequency and power level
35 indicating means 200 coupled thereto. Thus, the network operator can receive revenue from the use of the frequency, and simultaneously prevent radio

-12-

communications between base station 110 and terminal 120 from interfering with the cellular network.

Referring again to Figure 3, the remaining circuitry of base station 110 will now be described.

5 The design of the remaining circuitry of base station 110 is well known to those having skill in the art, and need not be described in detail. Microprocessor 360, for example a Zilog Z80 microcontroller, controls the base station 110. Radio transceiver 310 provides two-
10 way communications with the terminal 120 and network 102 via antenna 112. Signals received by antenna 112 are down converted by the radio transceiver 310, and provided to a demodulator 315. The demodulator produces a bit stream, i.e. a sequence of binary data
15 representing the received data. The bit stream is then provided to the receive digital signal processor (DSP) 355, where it is converted to an analog audio signal according to methods well known to those having skill in the art. The resultant analog signal is transferred
20 to the subscriber loop interface circuit 345. Loop interface circuit 345 is a commonly used circuit which provides the interface to the wired network 108, also referred to as the Public Switched Telephone Network (PSTN). PSTN 108 is the regular "wire line" telephone
25 system supplied by, for example, the regional Bell Operating Companies, and may use copper wire, optical fiber or other stationary transmission channels.

Still referring to Figure 3, receive DSP 355 is controlled by microprocessor 360. Microprocessor
30 360 provides timing signals and instructions. Operating instructions for the receive DSP 355 are typically contained in electrically erasable programmable read-only memory (EEPROM) 330. Flash ROM 335 typically contains instructions for the
35 microprocessor 360 itself. These instructions are uploaded into the microprocessor 360 during initialization. SRAM 325 is a static random access

-13-

memory which is typically used by the DSP 355 and the microprocessor 360 as a scratch pad memory for temporary storage of information. Power management and distribution circuits 340 are also connected to microprocessor 360.

To transmit, signals received from wire network 108 are coupled to the transmit DSP 320 by a loop interface circuit 345. The transmit DSP 320 digitizes the analog signal and converts it into a bit stream which is then passed onto the modulator 305. The transmit circuits basically perform complementary functions to those already described for the receive circuits.

Figure 4 illustrates a schematic block diagram of a radio transceiver 310 of Figure 3. As shown, transceiver 310 includes circuitry for both the reception and transmission of the radio frequency signals. Signals received by the antenna 112 are directed to the receive circuits by the duplexer 401. The duplexer is a filter with two separate bandpass responses: one for passing signals in the receive band and another for passing signals in the transmit band. In the ADC architecture, described above, the receive and transmit frequencies are separated by 45 mHz. The duplexer 401 allows simultaneous transmission and reception of signals.

After passing through the duplexer 401, received signals are amplified by a low noise radio frequency (RF) amplifier 402. This amplifier provides just enough gain to overcome the expected losses in the front end circuitry. After amplification, unwanted components of the signal are filtered out by the receive filter 403. After filtering, the signal is mixed down to a first intermediate frequency (IF) by mixing it in mixer 404 with a second signal generated by the channel synthesizer 415 and filtered by Local Oscillator (LO) filter 414. The first IF signal is

-14-

then amplified by amplifier 405 and unwanted mixing products are removed by IF filter 406. After filtering, the first IF is mixed in mixer 407 to yet another lower frequency or second IF signal, using a signal provided by local oscillator synthesizer 416. The second IF signal is then filtered by two filters 408 and 410, and amplified by multistage amplifiers 409 and 411 to obtain an IF signal 412 and a radio signal strength indication (RSSI) signal 413. Thereafter, it undergoes a process of detection, for example, as described in U.S. Patent 5,048,059 to Dent, the disclosure of which is incorporated herein by reference.

In order to transmit, a datastream 419 is generated by the transmit DSP 320 (Figure 3). In ADC architecture, the datastream is organized as bursts for time division multiplexing with other users. Reference oscillator 418 generates a precise frequency which is used as a stable reference for the RF circuits. The output of oscillator 418 is passed through a multiplier 421 where it experiences a sixfold increase in frequency. This frequency is then passed into a quadrature network 422 which produces two signals of equal amplitude which have a quadrature phase relationship, i.e. they are offset by 90°. These quadrature signals, along with the datastream 419, are combined in the modulator 423 to create a modulated signal, as described in an article entitled *I and Q Modulators for Cellular Communications Systems*, D. E. Norton et al., *Microwave Journal*, Vol. 34, No. 10, October 1991, pp. 63-79. The modulated signal is passed to a mixer 424 which translates the signal to radio frequency. The exact radio frequency is determined by the local oscillator signal provided by the channel synthesizer 415. The radio frequency signal is passed through a variable gain controlled amplifier 425. The gain of this amplifier, which is

-15-

controlled by means of a voltage on transmit power control line 420, determines the eventual output power, since the linear power amplifier 427 has fixed gain. Filtering is performed by transmit filter 426.

5 According to the invention, a frequency indicator 204 stored in smart card 202 is converted to a synthesizer command and applied to line 417 to produce the requisite transmit and receive frequency. A power level indicator 206 stored in smart card 202 is
10 converted to a transmit power control signal and applied to line 420 to control the transmit power. The conversions are preferably performed by microprocessor 360 using conventional techniques. Operations performed to set the frequency and power level will be
15 described below in connection with Figure 6.

Referring now to Figure 5, according to another embodiment of the invention, frequency and power level indicating means 200 can also be used in radio personal communications terminal 120 to control
20 the frequency and power level thereof and/or to control the frequency and power level of base station 110 by radio transmission. The design of terminal 120 is similar to that of base station 110 (Figure 3) except that a loop interface circuit 345 is not present. When
25 terminal 120 is a cellular phone, it includes a keypad 502, a display 504, a speaker 506, and a microphone 508. In order to provide a radio personal communications terminal for receipt and transmission of audio, video and data and/or multimedia signals, keypad
30 502 may be a full scale personal computer keyboard and display 504 may be a large graphics display. A scanner 510 may also be provided as may other devices 512 such as disk drives and modems. Apart from the use of smart card 200 for setting power levels and frequencies, the
35 design of terminal 120 is well known to those having skill in the art and need not be described herein.

-16-

Referring now to Figure 6, operations for controlling frequency and power level of a personal communications terminal and/or a base station, based upon stored frequency and power level information from a smart card, according to the invention, will now be displayed. It will be understood that other operations may be used.

Operations begin when power is applied to terminal 120 at Block 602. Upon application of power, the terminal 120 scans a set of control channels which are allocated to base stations 110, and determines if a signal level above threshold has been detected, at Block 606. It will be understood that each base station 110 is typically allocated only one of the set of control channels. If a signal level above threshold has been detected, then terminal 120 is within the range 114 of base station 110. If a signal level above threshold was not detected, then the terminal 120 is not within the range of base station 110 and communications are initiated with network 102 at Block 608, using conventional techniques.

Referring again to Block 606, if a base station control channel signal above threshold is detected, the terminal 120 locks onto the strongest signal at Block 610. Once locked on, terminal 120 performs a registration at Block 612. Similar to cellular phone systems, this registration information occurs at a predetermined power level and a predetermined frequency which depends upon the control channel which has been locked.

During the registration process, the base station 110 instructs the terminal 120 to tune to another frequency, to which the base station opens a channel and transmits at a defined power level. This can be the same frequency and power level which is determined by the frequency and power level indicators, or can be a different frequency and power level. Once

-17-

the transfer has been completed, the base station drops the control channel frequency to prevent another user from attempting to use the same base station.

According to the invention, the stored
5 frequency and power level indicators are obtained from the smart card 202 which is preferably removably coupled to the base station 110, but which may also be removably coupled to the terminal 120. At Block 616,
10 the obtained frequency and power levels are converted to signals which are used to set the synthesizer 415 and amplifier 425 for the unit which is removably coupled to the smart card. Signals representing a frequency and power level (the same frequency/power level or different frequency/power level) are then
15 transmitted to the other unit, which does not contain the smart card, at Block 618. That unit uses the received frequency and power level signals to set its synthesizer and amplifier at Block 620. Communications then take place between the base station 110 and
20 terminal 120 at the frequencies and power levels which were set in the earlier operations, at Block 622.

It will be understood by those having skill in the art that a separate voice channel frequency and power level may be stored in the smart card 202 for the
25 base station 110 and terminal 120. The power levels may be different for the base station and the terminal if, for example, the base station has a larger antenna or a more sensitive receiver. It is also contemplated that the frequencies will be different since the
30 terminal and base station would not typically transmit or receive on the same frequencies in a duplex transceiver. Alternatively, a single frequency and power level may be stored and a second frequency and power level may be determined from the single frequency
35 and power level.

Accordingly, the network provider can use a frequency and power level indicating means such as a

-18-

smart card, to allocate frequencies and power levels of base station-to-terminal communications. By allocating the frequency and power level of base station-to-terminal communications, same frequency interference
5 within a network cell is reduced and the network provider obtains additional revenue from the licensed frequency spectrum for the base station.

In the drawings and specification, there have been disclosed typical preferred embodiments of the
10 invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being set forth in the following claims.

-19-

CLAIMS:

1. A radio personal communications system comprising:

- a radio personal communications terminal
- 5 including first radio transceiving means;
 - a base station, electrically connected to a wire telephone network, and including second radio transceiving means for communicating with said first radio transceiving means; and
- 10 frequency indicating means, for removably coupling to at least one of said base station and said radio personal communications terminal, said frequency indicating means storing therein indications of at least one radio transmission frequency;
- 15 at least one of said radio personal communications terminal and said base station further comprising:

- means for removably coupling said frequency indicating means thereto;
- 20 means for obtaining from the removably coupled frequency indicating means, signals representing said at least one radio transmission frequency; and
- 25 means for controlling at least one of said first and second transceiving means to operate at a frequency corresponding to the at least one radio transmission frequency.

2. The radio personal communications system of Claim 1 further comprising a radio personal communications network, wherein said radio personal communications terminal further comprises:

- means for controlling said first transceiving means to communicate with said base station when said
- 35 radio personal communications terminal is relatively close to said base station, and for controlling said first transceiving means to communicate with said radio

-20-

personal communications network when said radio personal communications terminal is relatively far from said base station.

5 3. The radio communications system of Claim 1 wherein said frequency indicating means is a smart card.

10 4. The radio communications system of Claim 1 wherein said radio personal communications terminal comprises a radio telephone.

15 5. The radio personal communications system of Claim 4 wherein said radio telephone is a cellular telephone.

20 6. The radio personal communications system of Claim 2 wherein said radio personal communications terminal comprises a cellular telephone and wherein said radio personal communications network is a cellular telephone network.

25 7. A radio telephone comprising:
radio transceiving means;
means for controlling said radio transceiving means to communicate with a base station when said radio telephone is relatively close to said base station, and for controlling said radio transceiving means to communicate with a radio telephone network when said radio telephone is relatively far from said base station;

35 means for removably coupling frequency indicating means, including at least one stored indication of a radio transmission frequency;
means for obtaining from the coupled frequency indicating means, a signal representing said at least one radio transmission frequency; and

-21-

means for controlling said radio transceiving means to operate at a frequency corresponding to the at least one radio transmission frequency.

5 8. The radio telephone of Claim 7 further comprising means for transmitting to said base station, a second signal representing said at least one radio transmission frequency, whereby said base station
10 operates at a frequency corresponding to the at least one radio transmission frequency.

 9. The radio telephone of Claim 7 wherein said frequency indicating means further stores therein a second indication of at least one power level, and
15 wherein said radio telephone is further responsive to said second stored indication, for communicating with said base station at said at least one power level.

 10. The radio telephone of Claim 7 further
20 comprising means for processing voice, digital, video and multimedia communications to provide a radio personal communications terminal.

 11. A base station for a radio telephone
25 network comprising:
 means for electrically connecting said base station to a wire telephone network;
 radio transceiving means;
 means for receiving a frequency indicating
30 signal from external to said base station; and
 means, responsive to said external frequency indicating signal, for operating said transceiving means at a frequency corresponding to the received frequency indicating signal.

35

-22-

12. The base station of Claim 11 wherein said frequency indicating signal receiving means comprises:

means for removably coupling frequency
5 indicating means, including a stored indication of at least one radio transmission frequency; and
means for obtaining from the coupled frequency indicating means, signals representing said at least one radio transmission frequency.

10

13. The base station of Claim 11 wherein said frequency indicating signal receiving means comprises means for receiving a radio signal from a radiotelephone, corresponding to said frequency
15 indicating signal.

14. The base station of Claim 12 wherein said removably coupling means comprises means for removably coupling a smart card including said stored
20 indication of at least one radio transmission frequency.

15. The base station of Claim 11 wherein said frequency signal receiving means comprises means
25 for receiving a frequency indicating signal and a power level indicating signal from external to said base station; and wherein said operating means further comprises means for operating said transceiving means at a frequency and power level corresponding to the
30 received frequency and power level indicating signals.

16. A method of operating a radio personal communications system, said radio personal communications system comprising a radio personal
35 communications terminal including first radio transceiving means; and a base station, electrically connected to a wire telephone network, said base

-23-

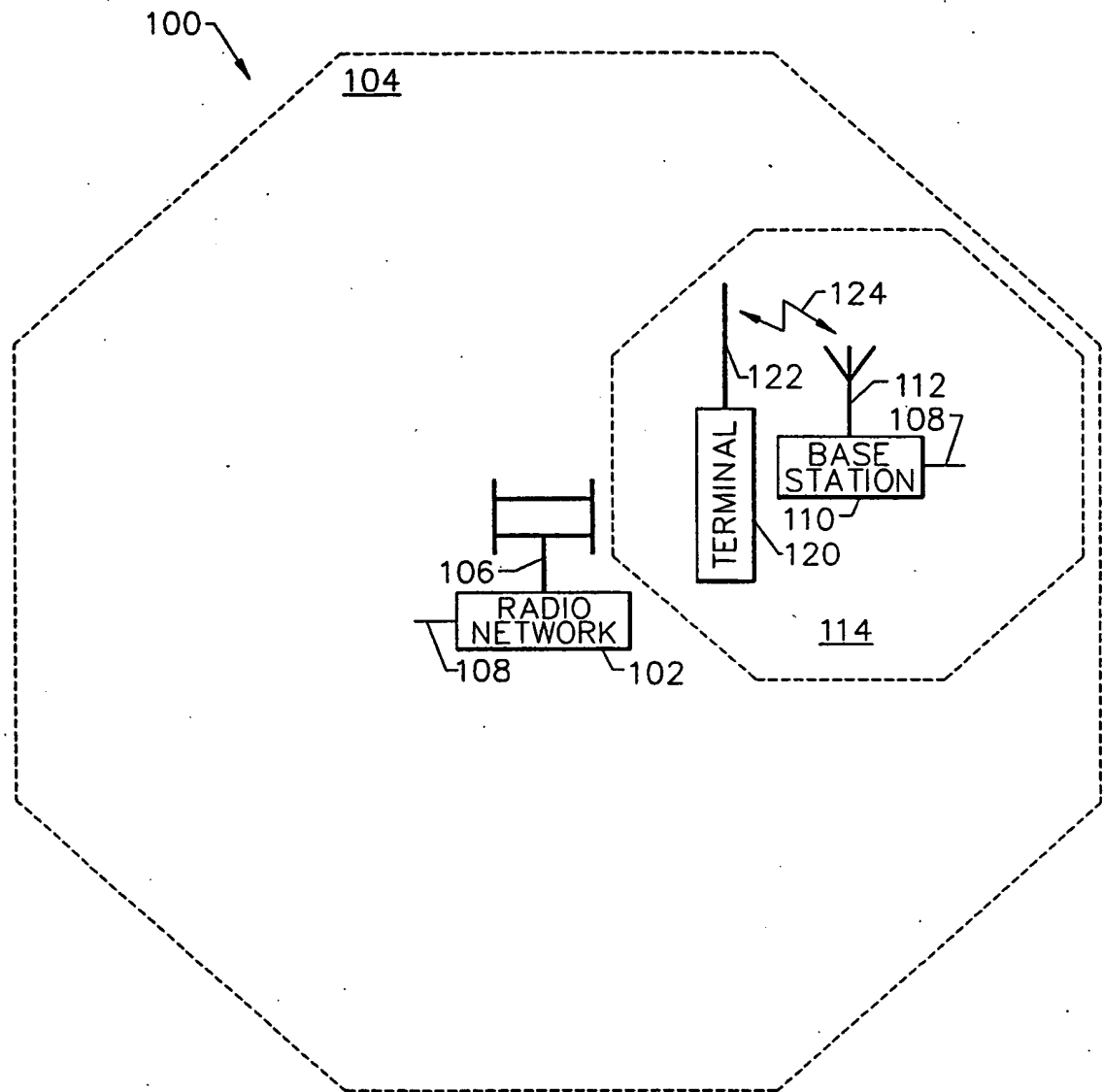
station including second radio transceiving means for communicating with said first radio transceiving means; said method comprising the steps of:

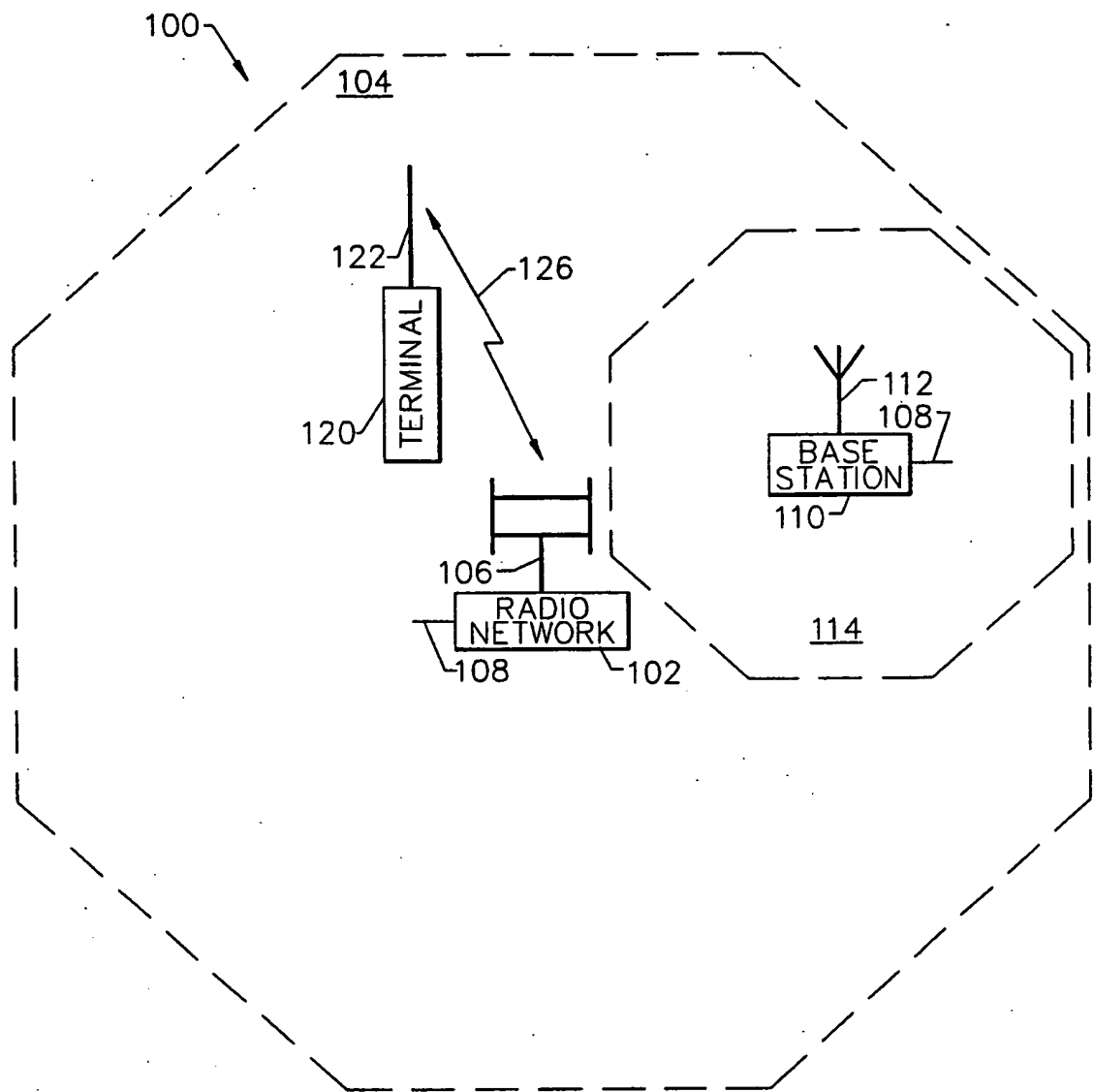
- removably coupling frequency and power level
- 5 indicating means to at least one of said base station and said radio personal communications terminal, said frequency and power level indicating means storing therein indications of at least one radio transmission frequency and power level;
- 10 obtaining from the removably coupled frequency and power level indicating means, signals representing said at least one radio transmission frequency and power level; and
- controlling at least one of said first and
- 15 second transceiving means to operate at a frequency and a power level corresponding to the at least one radio transmission frequency and power level.

17. The method of Claim 16 wherein said
- 20 radio personal communications system further comprises a radio personal communications network, wherein said method further comprises the steps of:

- controlling said first transceiving means to communicate with said base station when said radio
- 25 personal communications terminal is relatively close to said base station; and

- controlling said first transceiving means to communicate with said radio personal communications network when said radio personal communications
- 30 terminal is relatively far from said base station.

FIG. 1A.

FIG. 1B.

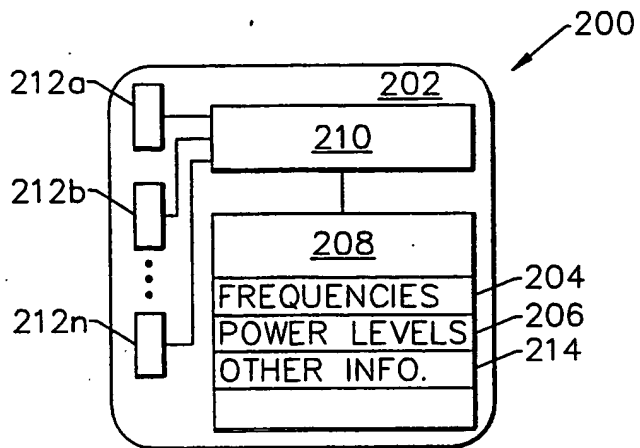


FIG. 2.

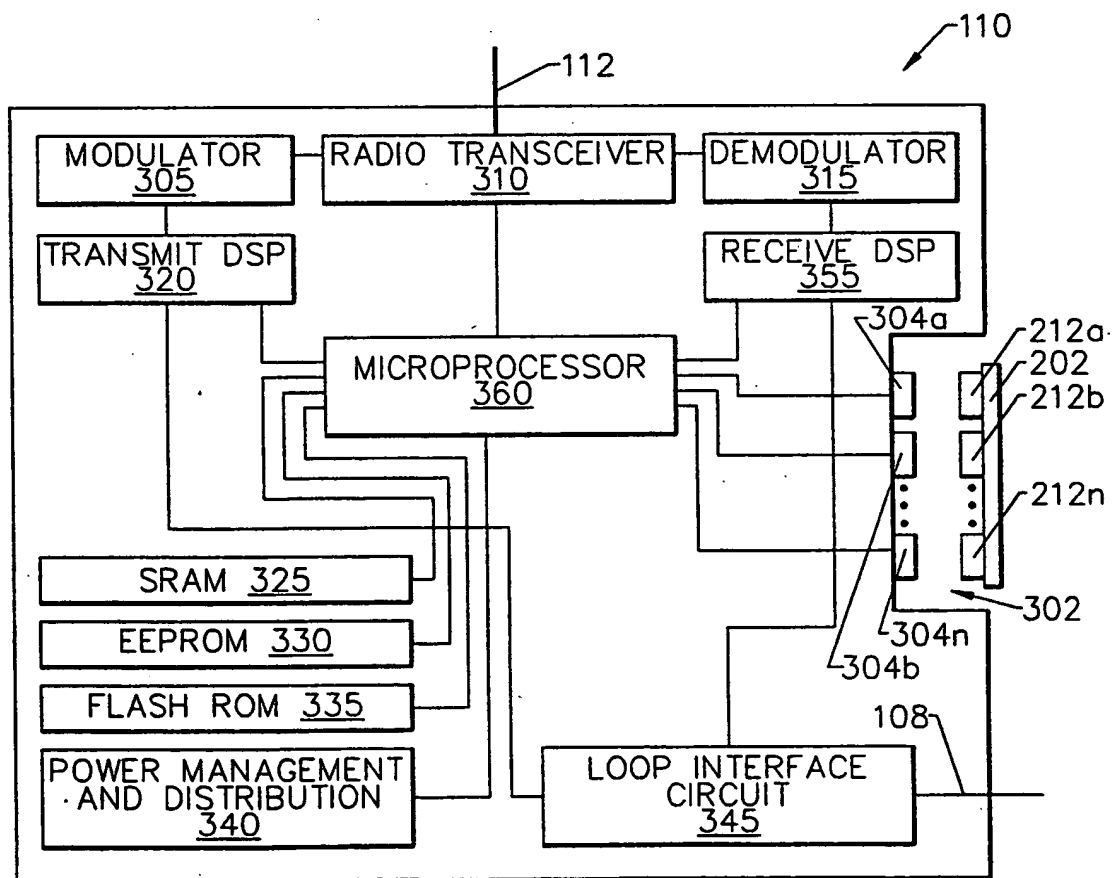
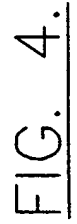


FIG. 3.



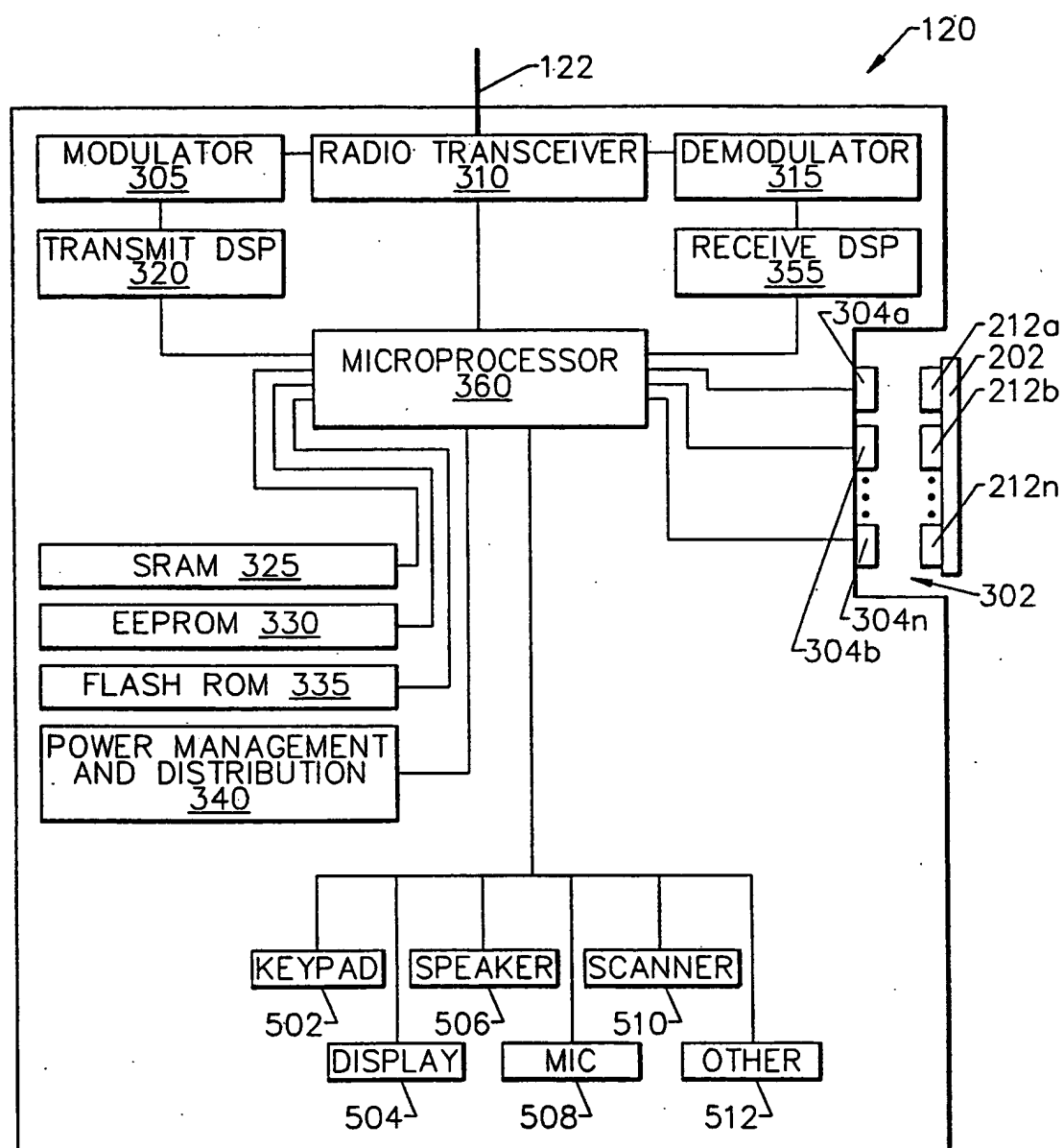


FIG. 5.

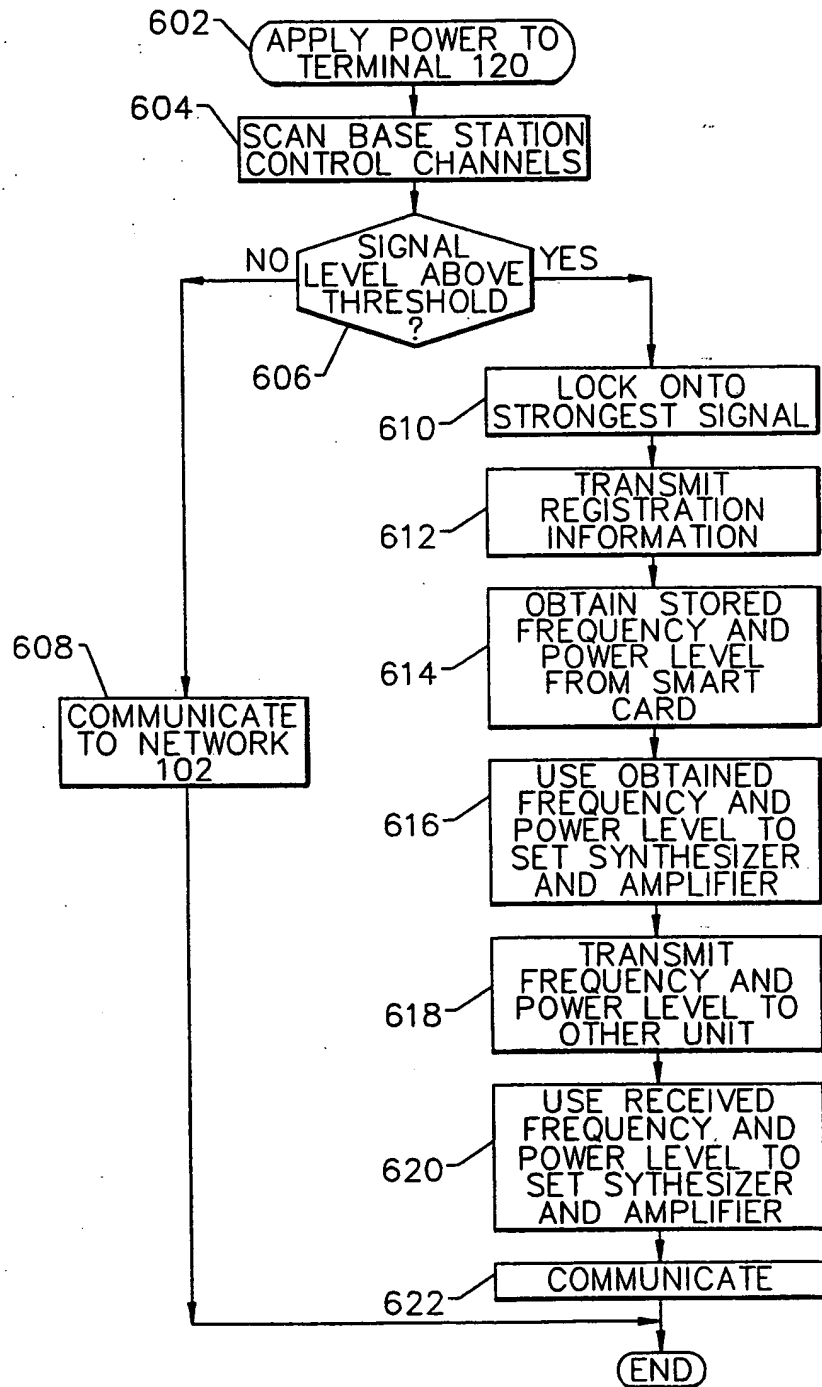


FIG. 6.

A. CLASSIFICATION OF SUBJECT MATTER IPC 6 H04B1/38 H04Q7/32 H04M1/72		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC 6 H04B H04Q H04M		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP,A,0 280 196 (NIHON KOHDEN CORPORATION) 31 August 1988	1
Y	see column 1, line 4 - column 2, line 24	2-7, 11, 12, 17
A	see column 3, line 28 - line 54 ---	16
Y	GB,A,2 260 468 (MATSUSHITA ELECTRIC INDUSTRIAL CO LTD) 14 April 1993	2, 4-7
A	see page 1, line 2 - line 7 see page 2, line 8 - page 3, line 9; claim 1 ---	16, 17
Y	EP,A,0 538 933 (PHILIPS ELECTRONICS UK LIMITED) 28 April 1993	3
A	see column 1, line 44 - line 54 see column 2, line 14 - line 24 see column 2, line 58 - column 3, line 9; claims 1, 7, 8 ---	1, 14, 16
-/--		
<div style="display: flex; justify-content: space-between;"> <input checked="" type="checkbox"/> Further documents are listed in the continuation of box C. <input checked="" type="checkbox"/> Patent family members are listed in annex. </div>		
* Special categories of cited documents : <div style="display: flex;"> <div style="flex: 1;"> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"I" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="flex: 1;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p> </div> </div>		
Date of the actual completion of the international search <div style="text-align: center; font-weight: bold;">28 October 1994</div>		Date of mailing of the international search report <div style="text-align: center; font-weight: bold;">17. 11. 94</div>
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016		Authorized officer <div style="text-align: center; font-weight: bold;">Goulding, C</div>

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y .	GB,A,2 225 512 (MOTOROLA INC) 30 May 1990 see page 1, line 11 - line 19 ---	11,12,17
A	US,A,5 020 130 (GRUBE ET AL.) 28 May 1991 see column 1, line 13 - line 23 -----	8,13

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-0280196	31-08-88	JP-B- 5083009 JP-A- 63207224 US-A- 4903322	24-11-93 26-08-88 20-02-90
GB-A-2260468	14-04-93	JP-A- 5102923	23-04-93
EP-A-0538933	28-04-93	JP-A- 5218946	27-08-93
GB-A-2225512	30-05-90	US-A- 4989230 JP-A- 3001621 US-A- 5127042	29-01-91 08-01-91 30-06-92
US-A-5020130	28-05-91	CA-A- 1300233 JP-A- 1255326	05-05-92 12-10-89

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☒ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.